

## REMARKS

No claims are amended, claims 8-11 are canceled, and no claims are added; as a result, claims 1-7, 12-77 and 186-189 are now pending in this application.

In the Office Action Summary, checkbox 4 states, "Claim(s) 1-77 and 186-189 is/are pending in the application." Applicant respectfully submits that this includes claims 45-49, and further, that claims 45-49 were not rejected in the Office action. Therefore, applicant respectfully requests that the next Office action indicate that claims 45-49 are allowed.

### §103 Rejection of the Claims

Claims 1-17, 19-25, 27-32, 34-36, 38-44, 50-77, and 186-189 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Havemann *et al.* (U.S. 6,358,849 B1) in view of Brown *et al.* (U.S. 6,168,704 B1). Applicant does not admit that Havemann *et al.* is prior art, or that Brown *et al.* is prior art, and reserves the right to swear behind Havemann *et al.* and Brown *et al.* as provided for under 37 C.F.R. § 1.131. Claims 8-11 are cancelled, so the rejection of these claims is moot. Applicant traverses the rejections of claims 1-7, 12-17, 19-25, 27-32, 34-36, 38-44, 50-77, and 186-189.

The Office action must provide specific, objective evidence of record for a finding of a suggestion or motivation to combine reference teachings and must explain the reasoning by which the evidence is deemed to support such a finding. *In re Sang Su Lee*, 277 F.3d 1338, (Fed. Cir. 2002). Applicant respectfully submits that the statement on page 3 of the Office action:

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to remove the barrier layer and the seed layer form selected areas and to deposit the conductor by a selective deposition process only in those areas left after the removal of the barrier layer and the seed layer in the invention of Havemann *et al.* for the disclosed intended purpose of Brown *et al.* of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents.

is not supported by the record.

Brown *et al.* at column 3, lines 7-15, states,

"Nevertheless, both the dual-damascene copper process flow, as shown in FIGS. 2A-2E, and the single-damascene copper process flow, as shown in FIGS. 1A-1E,

entail electroplating a copper layer across the entire conductive surface. This increases the cost of the raw materials and the amount of processing needed to remove the copper from undesired areas when compared to a method that enables a copper layer to be selectively deposited only to desired areas." (emphasis added)

Thus, any saving that might be taught or suggested to by Brown *et al.* (while applicant does not admit it to be so) relates to the copper layer, and not "to remove the barrier layer and the seed layer form [sic] selected areas" are recited in the Office action. Brown *et al.* at column 6, lines 18-21, states,

When the patterned photomask is subsequently removed, the portions of the barrier metal and copper seed layers 400A and 400B overlying the patterned photomask 407 are also removed, leaving the barrier metal and copper seed layers 400A and 400B selectively formed only in the opening 405.

Further, Brown *et al.* at column 6, lines 33-37, states, "portions of the barrier metal and copper seed layers 400A and 400B overlying the conductive layer 415 would effectively be removed, by being converted into a silicide that is later selectively covered by an insulating layer 420." (emphasis added) Applicant respectfully submits that Brown *et al.* fails to describe how any of *these* processes relate to "reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents." as recited in the Office action. Applicant respectfully submits that the reasoning of the Office action is defective, so the evidence does not support the finding. Thus, by failing to meet the standard of *In re Sang Su Lee*, the Office action fails to state a *prima facie* case of obviousness with respect to claims 1-7, 12-17, 19-25, 27-32, 34-36, 38-44, 50-77, and 186-189.

Assuming *arguendo* that there is a teaching, suggestion, or motivation to combine the references, applicant respectfully submits that the Office action still fails to state a *prima facie* case of obviousness with respect to claims 1-7, 12-17, 19-25, 27-32, 34-36, 38-44, 50-77, and 186-189.

Claim 1 recites, "removing the barrier layer and seed layer from selected areas of the insulator." Claims 4 and 12 recite, "removing the barrier layer . . . and seed layer from unused areas of the oxide layer." Claims 15, 19, 42, 56, and 67 recite, "removing the barrier layer . . . and seed layer from selected areas of the oxide layer." Claims 23 and 50 recite, "removing the barrier layer and seed layer from selected areas or unused areas of the oxide layer." Claims 27

and 34 recite, "removing the barrier layer and seed layer from selected areas of the polymer layer." Claim 30 recites, "removing the barrier layer and seed layer from selected areas or unused areas of the polymer layer." Claim 38 recites, "removing the barrier layer and seed layer from unused areas of the polymer layer." Claim 186 recites, "removing the barrier layer and seed layer from selected areas of the different insulator layer." (emphasis added in all cases to this point in the paragraph) In addition, claims 1, 4, 12, 15, 19, 23, 27, 30, 34, 38, 42, 50, 56, 67, and 186 all recite, "leaving a seed area." The Office action admits on page 2 that Havemann *et al.* fails to disclose, "removing the barrier layer and seed layer from selected areas of the insulator, and depositing the conductor by a selective deposition process after removing the barrier layer and the seed layer," and on page 4 that Havemann *et al.* fails to disclose, "removing the barrier layer and seed layer from selected areas of the oxide layer, and depositing the conductor after removing the barrier layer and the seed layer," but relies on Brown *et al.* to teach or disclose these elements. In contrast, Brown *et al.* at column 6, lines 14-21, states, "The barrier metal and copper seed layers 400A and 400B may be blanket-deposited in the opening 405 and on top of a patterned photomask 407 (shown in phantom in FIG. 4A) that was used to form the opening 405 in the first place. When the patterned photomask is subsequently removed, the portions of the barrier metal and copper seed layers 400A and 400B overlying the patterned photomask 407 are also removed, leaving the barrier metal and copper seed layers 400A and 400B selectively formed only in the opening 405." (emphasis added) Thus, Brown *et al.* fails to teach or suggest, "removal . . . from an insulator," and fails to teach or suggest, "removal from . . . an oxide layer," and fails to teach or suggest, "removal from . . . a polymer layer," and fails to teach or suggest, "removal from . . . different insulator layer," as recited in the claims as quoted above. In addition, applicant respectfully submits that the phrase "seed area" does not appear in Havemann *et al.*, and does not appear in Brown *et al.* Hence, neither Havemann *et al.* nor Brown *et al.*, either alone or in combination, teach or suggest all of the elements of claims 1, 4, 12, 15, 19, 23, 27, 30, 34, 38, 42, 50, 56, 67, and 186. Thus, the Office action has failed to state a *prima facie* of obviousness with respect to claims 1, 4, 12, 15, 19, 23, 27, 30, 34, 38, 42, 50, 56, 67, and 186.

Claims 2-3, 5-7, 13-14, 16-17, 20-22, 24-25, 28-29, 31-32, 35-36, 39-41, 43-44, 51-55, 57-66, 68-77, and 187-189 are dependent on claims 1, 4, 12, 15, 19, 23, 27, 30, 34, 38, 42, 50,

56, 67, and 186 respectively. For reasons analogous to those stated above and elements in the claims, applicant respectfully submits that the Office action fails to state a *prima facie* case of obviousness with respect to claims 2-3, 5-7, 13-14, 16-17, 20-22, 24-25, 28-29, 31-32, 35-36, 39-41, 43-44, 51-55, 57-66, 68-77, and 187-189. Therefore, applicant respectfully requests withdrawal of the rejections and reconsideration and allowance of claims 1-7, 12-17, 19-25, 27-32, 34-36, 38-44, 50-77, and 186-189.

In addition, on page 5 the Office action states, "Claims 8-17, 19-25, 27-32, 34-36, 38-44, 50-77, and 185-189, recite the same steps as claims 1 and 4, however, with specific material limitations imposed on the layers recited, as specifically addressed in the following." Applicant respectfully disagrees with this statement. For example, independent claim 56 recites, "depositing a layer of tantalum nitride above the conductor after removing the barrier layer and seed layer from selected areas of the oxide layer," which is not recited in either claim 1 or claim 4. Further, independent claim 186 recites, "depositing a different insulator layer over the planarized surface of the diffusion barrier layer," which is not recited in either claim 1 or claim 4. Therefore, applicant respectfully objects to the broad generalization that "claims 8-17, 19-25, 27-32, 34-36, 38-44, 50-77, and 185-189, recite the same steps as claims 1 and 4," as recited in the Office action. In addition, applicant respectfully submits that claim 185 is currently canceled, and has proceeded as though claim 185 was inadvertently included in this list. If this assumption by the applicant is incorrect, applicant requests a correction in the next Office action.

Further, applicant submits that the following statements used to support the rejection of claims 12-17, 19-25, 27-32, 34-36, 38-44, 50,77, and 186-189 in the Office action are unsupported in the cited references:

Page 5: "It would have been obvious to one having ordinary skill in the art at the time the invention was made to use a polymer instead of the fluorinated silicon oxide, since it was held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice."

Page 7: "Regarding the limitation that the seed layer is made of gold or silver, is well-known in the art."

Page 7: "Regarding the limitation that the conductive layer is made of gold, silver or aluminum, is well known in the art."

Page 7: "Regarding the limitation that the Al conductive layer is deposited on the seed layer by CVD is conventional, and hence well-known in the art."

Page 7: "Regarding the limitation that the Al conductive layer is deposited to an amount sufficient to fill the trench is obvious as this shows that it is well known and desirable in the art of forming a plug or interconnect."

Pages 7-8: "Regarding the limitation that the copper seed layer is deposited to a depth of approximately five-hundred angstroms thick, or to five-hundred angstrom below the top of the trench is trivial, since if it is deposited more than the specified amount, it is no longer a seed layer, but a conductive layer."

Page 8: "Regarding the limitation that the TaN barrier layer is deposited above the conductor to a depth of approximately five-hundred angstroms is an obvious matter of design choice within skill in the art that would not yield any unexpected results."

Page 8: " Regarding the limitation that the barrier layer is deposited to a depth of between fifty angstroms and one thousand angstroms is well known to one of ordinary skill in the art. It would have been an obvious matter of design choice to vary the size of the barrier layer, since such a modification would have involved a mere change in the size of a component."

Applicant respectfully submits that these statements are unsupported by the references and therefore within the personal knowledge of the Examiner. Therefore, applicant requests that the Examiner provide an affidavit as required by MPEP § 2144.03. If the Examiner can not provide an affidavit, applicant requests withdrawal of the rejections and reconsideration and allowance of claims 12-17, 19-25, 27-32, 34-36, 38-44, 50,77, and 186-189.

Claims 18, 26, 33, and 37 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Havemann *et al.* (U.S. 6,358,849 B1) in view of Brown *et al.* (U.S. 6,168,704 B1) as applied to claims 1-17, 19-25, 27-32, 34-36, 38-44, 50-77, and 185-189 above, and further in view of Ting *et al.* Again, applicant respectfully submits that claim 185 is canceled, and therefore has proceeded as though claim 185 was inadvertently included in this list. If this assumption by the applicant is incorrect, applicant requests a correction in the next Office action. Also, applicant has proceeded under the assumption that the document cited as "Ting *et al.*" in the Office action refers to U.S. Patent No. 5,969,422. Applicant respectfully notes that there is a

"Ting, C. H." as co-author of a document which was included in an Information Disclosure Statement mailed November 16, 1999 in connection with this matter. If the applicant's assumption in using U.S. Patent No. 5,969,422 is incorrect, applicant respectfully requests that the next Office action clarify which document is being cited, and allow applicant the opportunity to respond to that cited document. Further, applicant does not admit that Ting *et al.* (U.S. Patent No 5,969,422) is prior art, and reserves the right to swear behind Ting *et al.* as provided for under 37 C.F.R. § 1.131. Applicant traverses the rejections of claims 18, 26, 33, and 37.

The Office action must provide specific, objective evidence of record for a finding of a suggestion or motivation to combine reference teachings and must explain the reasoning by which the evidence is deemed to support such a finding. *Id.* The Office action, in an attempt to meet this requirement, on page 9, states, "It would have been obvious to one having ordinary skill in the art at the time the invention was made to an aluminum-copper seed layer instead of a copper seed layer and to form a conductor comprising any of gold, silver, aluminum, or copper, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice." Applicant respectfully submits that this statement fails to meet the standard of *In re Sang Su Lee*, as the statement fails to explain the reasoning by which the evidence is deemed to support a teaching, suggestion, or motivation to combine the reference teachings.

Assuming *arguendo* that there is a teaching, suggestion, or motivation to combine the references, applicant respectfully submits that the Office action still fails to state a *prima facie* case of obviousness with respect to claims 18, 26, 33, and 37.

Claims 18, 26, 33, and 37 depend from claims 15, 23, 30, and 34 respectively, and therefore contain all the elements of the claim from which they depend. Claim 15 recites, "removing the barrier layer of tantalum and seed layer from selected areas of the oxide layer, leaving a seed area." Claim 23 recites, "removing the barrier layer and seed layer from selected areas or unused areas of the oxide layer, leaving a seed area." Claim 30 recites, "removing the barrier layer and seed layer from selected areas or unused areas of the polymer layer, leaving a seed area." Claim 34 recites, "removing the barrier layer and seed layer from selected areas of the polymer layer, leaving a seed area." In contrast, Ting *et al.* at column 9, lines 52-65, states,

Another embodiment of the present invention is illustrated in FIG. 3, wherein an initial barrier layer 30 is deposited in opening 13 and on dielectric interlayer 10 or

optional etch stop layer 12, for additional prevention of Cu migration. Barrier layer 30 can comprise a refractory metal, refractory metal alloy or refractory metal compound, preferably Ta, W or a nitride thereof. Subsequently, catalytic seed layer 14, comprising an alloy of Cu and a refractory metal, is deposited on barrier layer 30 within opening 13 and on dielectric interlayer 11. Cu or a Cu-base alloy 15 is then electrolessly plated or electroplated on Cu-refractory metal catalytic seed layer 14 filling opening 13 and forming a thin layer on dielectric interlayer 11. Subsequent processing then continues in a manner similar to that illustrated in FIG. 2. (emphasis added)

Hence, Ting *et al.* fails to teach or suggest "removing the barrier layer and seed layer . . . leaving a seed area" as recited in the claims. Applicant respectfully submits that the phrase "seed area" does not appear in Ting *et al.* For these reasons and for reasons analogous to those given above, applicant respectfully submits that neither Havemann *et al.*, nor Brown *et al.*, nor Ting *et al.*, either alone or in combination, teach or suggest "removing the barrier layer . . . and seed layer . . . leaving a seed area" as recited in claims 15, 23, 30, and 34. Hence, neither Havemann *et al.*, nor Brown *et al.*, nor Ting *et al.*, either alone or in combination, teach or suggest all of the elements of claims 18, 26, 33, and 37. Thus, the Office action has failed to state a *prima facie* of obviousness with respect to claims 18, 26, 33, and 37. Therefore, applicant respectfully requests withdrawal of the rejections and reconsideration and allowance of claims 18, 26, 33, and 37.

Conclusion

Applicant respectfully submits that the claims are in condition for allowance, and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's attorney at (612) 371-2109 to facilitate prosecution of this application.

If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

Respectfully submitted,

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CERTIFICATE UNDER 37 C.F.R. § 1.8: The undersigned hereby certifies that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail, in an envelope addressed to: MS Amendment, Commissioner of Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on this 23<sup>rd</sup> day of November, 2004.

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